

Case Study 2: India Community Adaptation to Drought in Rajasthan

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1 Introduction

Historic and continued high rates of greenhouse gas (GHG) emissions from anthropogenic sources are responsible for current climate change. The atmospheric lifetime of these greenhouse gases ranges from decades to centuries. Therefore, some climate change is inevitable in the short and medium term, even after taking all measures to reduce concentration of GHGs by the developed countries, as per the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. As a result, the impacts of climate change are expected to continue and even increase in the coming years.

Climate change is not only a major global environmental problem but also an issue of great concern to India. It is likely to threaten food security, increase water stress and decrease availability, result in sea level rise, and increase the occurrence of diseases like malaria. Lack of resources and access to technology and finances coupled with high dependence of the majority of people on climate sensitive sectors (i.e. agriculture, forestry and fisheries) have made India seriously concerned about possible climate change impacts. Therefore adaptation to climate change is a necessity for India.

India, with a population of over 1 billion, and whose growth is projected to continue in the coming decades, is vulnerable to possible impacts of climate change. India is an agrarian society, with 64 per cent of its population dependent on agriculture, contributing 22.61 per cent to India's gross domestic product (GDP) in 2001–2. Agriculture in India is highly dependent on the South-West Monsoon (June–September), indicating its vulnerability to climate change.

1.1 India's vulnerability to climate change

India's Initial National Communication to the UNFCCC (MoEF 2004) assessed the impacts and studied the vulnerability of various sectors to climate change and brought out the following, depicting vulnerability:

- increase in water stress and reduction in availability of fresh water
- threats to agriculture and food security
- shifts in area and boundary of different forest types and threats to bio-diversity with adverse implications for forest dependent communities
- adverse impacts on natural ecosystems
- adverse impacts of sea level rise on coastal agriculture, fisheries and settlements
- adverse impacts on human health
- increased energy requirement and impact on climate sensitive industries and infrastructure.

1.2 India's varied climates and the monsoon

India experiences varied climates, but the most important climatic feature of the Indian sub-continent is the South-West Monsoon during June–September. Almost all regions of the country receive their entire annual rainfall during the summer monsoon, on which people and the agrarian economy are critically dependent. The monsoon in India has a direct link with the Southern Oscillation Index (SOI): weak monsoons are associated with a large negative SOI and occurrence of El Niño, whereas strong monsoons have been linked to large positive SOIs and absence of El Niño events. The frequency of El Niño events is likely to increase due to climate change.

Figure 1: Location Map of Rajasthan



1.3 Arid and semi-arid climate

There are large tracts in northwestern India and the interior peninsula that experience arid conditions. The state of Rajasthan is situated in such an arid area. According to India's initial national communication, submitted to the UNFCCC (MoEF 2004), 60 per cent of the state is likely to experience acute physical water scarcity conditions during the period 2040–61.

1.4 The Rajasthan case study on linking climate adaptation

The case study focuses on traditional adaptation practices used by vulnerable communities in a drought prone area: we have selected the Tonk district, in the state of Rajasthan, which experienced severe drought conditions during 2002. The communities have been chosen as they are the people who are bearing the brunt of existing drought. They have learned over the years about traditional practices, and with the local non-governmental organisation

(NGO) movement helping them to take the initiatives to cope with such situations, they understand what is happening on the ground. Therefore they are the best placed to articulate any policy and financial interventions required to build their resilience and coping capacity against droughts. The case study brings out traditional practices adopted by the communities in case of droughts which have been practiced over generations. Communities possess immense banks of knowledge on traditional water management practices and foodgrain and fodder storage practices. Furthermore, the study identifies response measures and policy initiatives, already taken up by the government and other stakeholders (e.g. funding agencies, NGOs); analyses gaps in the existing policies and suggests widening of existing government programmes, including simplification of rules and procedures for availing facilities provided under various policies/programmes. Most government schemes for the poor are curative in nature. The ability of the poor to adapt and increase

Table 1: Decadal Growth Rate of Urban Population in India

| Year | Percentage of urban to total population |
|------|---|
| 1951 | 17.3 |
| 1981 | 23.3 |
| 1991 | 25.7 |
| 2001 | 30.5 |

Source: www.urbanindia.nic.in/scene.htm
(accessed 9–15 September 2004)

their resilience and coping capacity would further be strengthened by preventive measures. There also exists a wide gap between planning and implementation. Hence, there is a need for proper coordination at various levels to make programmes successful.

2 Climate change and India

2.1 Political background

India is the world's largest democracy; the legislature, the executive and the judiciary (which is strong and formally independent) constitute the three building blocks of the Indian Constitution. The Indian parliament consists of two houses, Rajya Sabha (Upper House) and Lok Sabha (Lower House). India has a unique system of federation

with a manifest of unitary character. The prime minister of India is the head of government.

At present, India is governed by the United Progressive Alliance (UPA), a coalition led by the Indian National Congress, which obtained the highest number of seats, installing Dr Manmohan Singh as the prime minister. The UPA is currently being supported by the Left Front, a group of left-wing parties dominated by the Communist Party of India (Marxist).

2.2 Economic background

Two-thirds of India's population works in the agricultural sector, with agriculture, forestry and fishing accounting for around 22 per cent of total GDP. However, the majority of landholdings are at subsistence level and many farming families live below the poverty line. India has some of the lowest human development indicators in the world, particularly in rural areas.

Agricultural production, mainly foodgrains, accounts for around one-quarter of GDP (at factor cost) and is an important determinant of overall economic growth. Total foodgrain production in 2003/04 (April–March) is estimated to be a record 220 million tonnes. Rice and wheat are the major staple food crops with oilseeds, cotton, pulses, sugarcane, tea, coffee, rubber, jute, potatoes and vegetables grown in various locations of the country.

A policy of import substitution in the decades after independence encouraged the development

Table 2: Comparison of National Circumstances for the Last Decade

| Criteria | 2003–4 | 1994 |
|--|---------|-------|
| Population (million) | 1,049.5 | 914 |
| Area (million square km) | 3.29 | 3.29 |
| GDP <i>per capita</i> US\$ | 565 | 294 |
| Share of industry in GDP | 22% | 27.1% |
| Share of services in GDP | 56% | 42.5% |
| Share of agriculture in GDP | 22% | 30.4% |
| Population below poverty line (%) | 31.4% | 36% |
| Life expectancy at birth (years) | 63.6 | 61 |
| Adult literacy rate (percentages 15 and above) | 65.4% | 57% |

Sources: MoEF (2004), www.edition.cnn.com/2004/WORLD/asiapcf/08/31/India.eye.economy, www.en.wikipedia.org/wiki/2004/, hdr.undp.org/statistics/data/cty/cty_f_IND.html, www.hdr.undp.org/statistics/data/cty/cty_f_IND.html, www.indiarural.org/india.html (websites accessed 15 September–25 October 2004)

of a broad industrial base. However, a lack of competition contributed to poor product quality and inefficiencies in production. Several sectors have now been opened up to foreign participation under India's liberalising reform programme, contributing to a significant expansion in the production of durable consumer goods, including cars, scooters, consumer electronics, computer systems and white goods and contributes 22 per cent to the GDP. Services have proved India's most dynamic sector in recent years, registering rapid growth in telecoms and information technology (IT) and accounts for over 56 per cent of GDP.

India's economy grew at an unexpectedly robust 8.4 per cent in the current year through the third quarter, making it one of the fastest growing in the world. With a *per capita* gross national income (GNI) of US\$470 in 2002, there is a broad consensus that poverty in India has fallen in the past decade. Yet, more than one out of every four Indians is poor.

2.3 Geography and demography

India's total land mass is 3.29 million square kilometres and is divided into three main geological regions: the Indo-Gangetic Plain, the Himalayas and the Peninsula region. The climate of India varies from tropical monsoon in the south to temperate in the north. India's population grew by 180 million people in the last ten years, though the rate of its population growth has apparently declined in recent years. Out of the present population of 1.073 billion 51.7 per cent is male and 48.3 per cent female. The 2001 Census shows that overall illiteracy rates are now declining for the first time since independence. For those aged seven or above, literacy rates now stand at 65.38 per cent (in 1991 the figure was 52 per cent). About one-third of Indians (an estimated 300 million) live below the poverty line. Unemployment is also a major problem, with 10 million new entrants into the job market each year.

2.4 Human Development Index

Overall, human development as reflected in the Human Development Index (HDI), has improved significantly between 1980 and 2001. India ranks 127 out of 177 countries in terms of HDI in the *Human Development Report* of United Nations Development Program (UNDP) 2002. The life expectancy ratio improved from 63.3 in 2001 to 63.6 in 2002, while adult literacy rate went up from 58 to 61.3. Human poverty on the Human Poverty

Index (HPI) declined considerably during the 1980s (from almost 47 per cent in the early 1980s to about 39 per cent in the early 1990s). The decline has been marginally more in rural areas, resulting in a narrowing rural-urban gap. During the last 50 years, the population of India has grown two and half times, but urban India has grown by nearly five times. Decadal growth of urban population in India is given in Table 1.

Table 2 provides a vivid comparison of national circumstances for the fiscal year 1994 and 2003–4.

2.5 National economic and social development for future

With slow but steady improvement in the overall growth of economy and the well-being of the people, the Government of India further emphasises the following targets to achieve its developmental goals:

- Double the *per capita* income by 2012
- Reduction in poverty ratio by 5 per cent by 2007 and by 15 per cent by 2012
- Reduce decadal population growth rate to 16.2 per cent during 2001–11 (from 21.3 per cent during 1991–2001)
- All children to complete five years of schooling by 2007
- Increase literacy rate to 75 per cent by 2007 (from 65 per cent in 2001)
- Between 2002 and 2007 halve gender gaps in literacy and wage rates
- Reduction of Infant Mortality Rate (IMR) to 45 per 1,000 live births by 2007 and to 28 by 2012 (115 in 1980, 70 in 2000)
- Reduction of Maternal Mortality Rate (MMR) to two per 1,000 live births by 2007 and to one by 2012 (from three in 2001)
- 25 per cent reduction in morbidity and mortality due to malaria by 2007 and 50 per cent by 2010
- Increase in forest and tree cover to 25 per cent by 2007 and 33 per cent by 2012 (from 23 per cent in 2001)
- Sustained access to potable drinking water in all villages by 2007
- Electrify 62,000 villages by 2007 through conventional grid expansion, the remaining 18,000 by 2012 through decentralised non-conventional sources like solar, wind, small hydro and biomass
- Create 50 million employment opportunities by 2007 and 100 million by 2012 (the current

Table 3: Possible Health Concerns Due to Climate Change

| Health concerns | Vulnerabilities due to climate change |
|---|---|
| Temperature-related morbidity | Heat- and cold-related illnesses Cardiovascular illnesses |
| Vector-borne diseases | Changed patterns of diseases Malaria, filaria, kala-azar, Japanese encephalitis, and dengue caused by bacteria, viruses and other pathogens carried by mosquitoes, ticks and other vectors |
| Health effects of extreme weather | Diarrhoea, cholera and poisoning caused by biological and chemical contaminants in the water (<i>even today about 70% of the epidemic emergencies in India are water-borne</i>) Damaged public health infrastructure due to cyclones/floods Injuries and illnesses Social and mental health stress due to disasters and displacement |
| Health effects due to insecurity in food production | Malnutrition and hunger, especially in children |

backlog of unemployment is around 9 per cent, equivalent to 35 million people)

- Cleaning of all major polluted rivers by 2007 and other notified stretches by 2012
- Halt HIV/AIDS spread by 2007.

2.6 India and the Millennium Development Goals (MDG)

The tenth five-year plan also reflects the Government of India's commitment to the United Nations Millennium Development Goals agreed in 2000. The UN goals include halving extreme poverty, halving the proportion of people without sustainable access to safe drinking water, halting the spread of HIV/AIDS and enrolling all boys and girls everywhere in primary schools by 2015. Many of the Indian national targets are more ambitious than these goals and reflect the commitment of the Government of India to the UNFCCC, Rio Declaration (1992) on Agenda 21, Millennium Declaration at the UN Millennium Summit, Johannesburg Declaration at the World Summit on Sustainable Development (2002) and the Delhi Declaration (2002) at the eighth Conference of Parties (COP) to the UNFCCC.

These specific planning targets address many climate change concerns. For example, reduced poverty and hunger would enhance people's adaptive capacity, reduced decadal population

growth rates would lower GHG emissions, reduce pressure on land, resources and ecosystems, and provide wider access to social infrastructure. Increased reliance on hydro and renewable energy resources would reduce GHG and local pollutant emissions, enhance energy security and consequent economic benefits from lower fossil fuel imports and provide access to water resources from additional hydro projects. The cleaning of major polluted rivers would result in enhanced adaptive capacity due to improved water, health and food security. These measures also address sustainable development aiding the social and economic well-being of communities.

It is thus clear that the Indian planning process in internalising global climate change concerns is bold and robust. Taking care of national planning objectives would include addressing many specific climate change concerns; these are dealt with in more detail in this section.

2.7 Specific climate change concerns Water stress and reduction in the availability of fresh water

The preliminary assessment during the Initial National Communication to the UNFCCC (hereafter NATCOM) (MoEF 2004) revealed that the severity of drought and floods in various parts of India is going to increase due to climate change.

Table 4: A Comparative Situation of Drought for the Last Five Years

| Year | 1998 | 1999 | 2000 | 2001 | 2002 (Estimated) |
|------------------------------------|--------|--------|--------|-------|-------------------|
| No of villages affected | 20069 | 23406 | 30583 | 7965 | 41000 |
| Affected population (in '00,000) | 215.07 | 261.79 | 330.41 | 69.70 | 432.68 |
| No of cattle affected (in '00,000) | 295.78 | 345.60 | 399.69 | 69.73 | 543.48 |
| Crop damages | | | | | |
| (a) Area (in <i>lakh</i> ha) | 64.96 | 78.18 | 89.47 | 26.83 | 117* |
| (b) Cost (in million rupees) | 22830 | 34070 | 35120 | 12520 | 44140 |
| Rainfall reduction | -3% | -16% | -29 | -5% | -55% (09/09/2002) |

*Out of a sowing target of 129 *lakh* hectares only 60.69 *lakh* ha could be sown, of which 48.06 *lakh* ha of the crop was completely destroyed. Due to the absence of rain in July 69 *lakh* ha could not be sown. Hence, total damage of land is 48.06+ 69=117.06 *lakh* ha. (1 *lakh*=1000)

Most parts of India would have seasonal/regular water scarcities and shortages, while 25 per cent of Gujarat and 60 per cent of Rajasthan would have acute physical water scarce conditions. It is estimated that groundwater levels have already declined by 0.34 million km³. Possible effects of climate change on groundwater are:

- changes in precipitation and evapotranspiration may influence groundwater recharge
- rising sea level may lead to increased saline intrusion of coastal and island aquifers
- increased rainfall intensity may lead to higher run-off and less recharge
- Increased flood events may affect groundwater quality in alluvial aquifers.

Threats to agriculture and food security

Foodgrain production in India has increased spectacularly due to the Green Revolution from 50 Mt (million tonnes) in 1951 to 212 Mt in 2002. But productivity is still very low and production is mostly dependent on rainfall during monsoon months. The food security of India may be at risk due to continued population growth, environmental degradation and significant slow down of the growth rate in cultivated areas. Concerns have been expressed lately that the rice-wheat cropping system is already showing trends of stagnation/decline in its productivity: climate change is definitely going to affect major crops like rice, wheat, maize, sugarcane and *Brassica*. Various locations in India will be affected differently under climate change, with some locations gaining in agricultural

productivity (rice in Southern India and *Brassica* in Northern India) while others will lose (wheat, sugarcane and maize in Northern India).

Threat to forestry and biodiversity

Approximately 70 per cent of forest locations are expected to experience a change in the prevailing biome type with most the seriously impacted being dry and moist savannah.

Future biodiversity is projected to decrease due to multiple pressures, in particular increased land use and the associated destruction of natural or semi-natural habitats. There is also evidence suggesting that climate change may increase species losses as species habitats move pole ward or upward in altitude from their current locations.

Changes in forest boundaries of different forest types and biodiversity are going to affect the production and supply of non-timber forest products to forest dependent communities, affecting their livelihoods. About 200 million people depend on forests directly or indirectly, thus vulnerability may increase for about 200,000 villages in India situated in, or near, the fringes of forests.

Adverse impacts on natural ecosystems

The major non-forest natural ecosystems in India are wetlands and grasslands. Wetlands include marine ecosystems such as coral reefs; coastal ecosystems such as mangroves; and inland ecosystems such as rivers, lakes and marshes.

Likely impacts are submergence and/or salinisation of wetlands. Increased sea surface temperature resulting in bleaching of corals and

Table 5: Rainfall in 2002

| District | Normal (mm) (1 June–15 September) | Actual (mm) (1 June–11 September) | Deviation from normal (%) |
|----------|--------------------------------------|--------------------------------------|---------------------------|
| Jaipur | 443.4 | 152.0 | –66 |
| Sikar | 376.1 | 165.8 | –56 |
| Tonk | 513.5 | 173.4 | –66 |

Source: Hydrology department.

could, if higher constant temperatures persisted, result in death of corals. Desiccation of marshes, swamps and shallow lakes may be other possible impacts of climate change.

Adverse impacts of sea level rise

Sea level rise has significant implications on coastal populations and agricultural performance in India. A variety of impacts are expected including:

- land loss and population displacement
- increased flooding of low-lying coastal areas
- agricultural impacts (like loss of yield and employment) resulting from inundation, salinisation and land loss
- Impacts on coastal aquaculture
- Impacts on coastal tourism, particularly erosion of sandy beaches

Adverse impacts on human health

Changes in climate may alter the distribution of important vector species (e.g. mosquitoes) and may increase the spread of diseases to new areas that lack strong public health infrastructure. High altitude populations that fall outside areas of stable endemic malaria transmission may become particularly vulnerable to increases in malaria. Some possible key health impacts are shown in Table 3.

Increased energy requirement and impact on climate sensitive industry and infrastructure

The climate change impact analysis on energy infrastructure indicates that a rise in average temperature increases the need for space cooling in buildings and transport sectors. The variability in precipitation can also impact irrigation needs and consequently increase demand for energy, resulting in higher emissions. Infrastructure is vital and is where huge investments are being committed

in developing countries, but is a sector creating long-life and open-to-weather assets that will face increasing impacts from the changing climate.

3 Adaptation to drought in Rajasthan

3.1 Background

The state of Rajasthan experiences an arid, semi-arid climate resulting in severe droughts, the magnitude of which varies from year to year. Drought has been a continuous phenomenon in Rajasthan ever since the beginning of twentieth century, but severity has increased in the last couple of decades with 1987–8 and 2002–3 being the worst. The intensity and frequency of drought in Rajasthan is expected to increase in the coming years due to climate change. Table 4 shows a comparative situation of drought for the last five years.

Communities have therefore learned to conserve and judiciously use natural resources, particularly water, since historical times. Due to the vulnerability of the state to recurring drought conditions, communities have drawn the attention of various stakeholders (government, development agencies and NGOs) that have supported developmental initiatives both at policy and local levels.

3.2 Background of the district chosen for Rajasthan case study

Based on meteorological evidence, it was found that the Tonk district was worst affected by the drought which occurred in 2002. Tonk district was chosen as the representative survey area because it is located in the heart of Rajasthan and truly depicted the climatic variations which took place in the state. The Tonk district received scanty rainfall and as a result of this, the region faced famine-like conditions. People living in this area became increasingly vulnerable because of non-availability

of water for irrigation and reduced fodder for cattle. Thus, the Tonk district suffered the most due to repetitive occurrence of droughts.

Tonk, in the erstwhile princely state of Rajasthan, is located in its northeastern part between longitudes 75°07' and 76°19' and latitudes 25°41' and 26°34'. It is bounded in the north by Jaipur district, in the south by Bundi and Bhilwara districts, in the west by Ajmer and in the east by Sawai Madhopur (Figure 1). The total geographical area of the district is 716,309 ha. It has an elevation of about 264.32 m above sea level. The only important river of the district, the Banas, bisects it. The soil is somewhat sandy but fertile. *Rabi* crops (sown in November and harvested in February) are the principal crops and include groundnut, barley and gram. The important *kharif* crops (sown in June/July and harvested in September/October) are cotton, maize, *bajra*, *jowar* and sugarcane.

The Tonk district suffered the most severe droughts in comparison with two other most severely affected districts (see Table 5).

3.3 Natural resource scenario

For this study, we visited two severely affected villages in the district of Tonk: Dotana and Safipura, with a population of 1,400 and 300 respectively. The average size of families is six to seven people per household, with the principle of agriculture and animal husbandry. Agriculture is mainly rain-fed and subsistence due to sandy soil and scarcity of water for irrigation, whereas cattle rearing is revenue earning. The 2002 drought was the fifth year in succession in the state, but intensity of water scarcity in 2002 was more severe and its magnitude much wider than previous drought years. With successive occurrence of severe drought in most places, there was little water left in ponds, wells and hand pumps. Nearly 30 per cent of hand pumps have now dried up with the same percentage becoming dysfunctional systems. Water levels in ponds have decreased over the years and now water is also not available for agricultural purposes. There was massive crop failure in 2002, and due to immense crop damage, there was scarcity of fodder too. This resulted in the abandoning of livestock taking a heavy toll on their lives. The 2002 drought put a question mark on some of the important issues in the state: i.e. drinking water, agriculture, livestock and fodder, employment opportunities and food security and the preparedness of the state and communities to such droughts.

3.4 Social scenario

Drought affects people's lives in many ways other than only putting hardship on them to sustain themselves and their livestock. In most villages, only primary standard government schools (Vth standard) exist. Villagers send their children to pursue their studies in these primary schools, where education is free. But some money (in terms of books, minimum annual fees, uniforms) is always spent by villagers to provide education. With successive occurrences of drought, villagers find it difficult to even account for these minimum expenses, and discontinue their children's education. Only if they subsequently succeed to earn by growing crops, do they send their children to school. So, if drought occurs continuously year on year, their children's education is in jeopardy. To continue their children's study further, they send their children to secondary schools (Xth standard) which are located in distant places. But girls receive education only up to primary standard, as the villagers are hesitant to send girls for higher education.

Medical facilities are absent in most villages. Communities use private doctors by travelling to nearby villages and the hospital located at the block headquarters. They save money to meet these unexpected expenses: financing vehicle hire to go to the hospital is expensive and villagers find it difficult to pay for this transportation, which is over and above expenditure on treatment.

3.5 Impacts of 2002–3 droughts in Rajasthan

The years 2002–3 witnessed severe drought in many states but Rajasthan was the worst affected due to the drought in the state during previous four consecutive years. The overall impact of drought in the year 2002–3 in Rajasthan is summarised below:

- All the 32 districts were severely affected by drought with less than 55 per cent of average rainfall.
- Nearly 40 million people were affected.
- About 50 million livestock were affected.
- More than 30 per cent of the hand pumps dried up and almost the same percentage became dysfunctional.
- Most of the male population migrated to towns to earn livelihoods as daily wage labourers.

Table 6: Comparison of Severity of Drought

| Parameters | 1987–8 | 2002–3 |
|----------------------------------|--------|--------|
| Rainfall deficiency | –45% | –55% |
| Districts affected | 27 | 32 |
| Villages affected | 36252 | 41000 |
| <i>Tehsils</i> * affected | 208 | 241 |
| Affected population (10 million) | 3.17 | 4.32 |
| Affected livestock (10 million) | 3.27 | 5.43 |

*A *tehsil* is an administrative subdivision or tier of local government in some South Asian countries. A *tehsil* is typically part of a district, and typically contains villages and/or municipalities.

Source: Compiled from the *Akal Times*, October 2002–June 2003.

Agriculture

- Out of a targeted 12.9 million ha of cultivable land, only 6.06 million ha were sown for crops. Out of this, crops in 4.86 million ha were damaged due to scarce rainfall. Hence, only 1.2 million ha of land were suitable for growing crops.

Livestock

- Fodder scarcity, due to crop failure and higher prices of available fodder took a heavy toll on the cattle population.

Employment

- Daily wages of labourers were reduced from Rs60–70/day to Rs30–40/day.
- Out of a targeted 0.5 million employed through the Food-for-Work Programme, only 0.25 million were employed.

Food security

- Due to water scarcity, crops could not grow to meet people's regular requirements; neither could they buy food from the open market as they did not have enough hard currency. This resulted in food insecurity which drove many farmers to commit suicide.

Table 6 depicts the severity of drought in 2002 in comparison to 1987–8 which was until then considered a catastrophic event in Rajasthan.

3.6 The story of the vulnerable community

Previous situation

Meeting with villagers, particularly with the older generation, reveals that the situation was different

in earlier times. It was easier for them to cope with droughts because of lower population, the size and pattern of land holding was different and only half of the land was being used for agricultural purposes. With a lower population and less cultivated land, pressure on water resources was reduced thus helping the community to manage the available water resources in an efficient manner.

The communities perceived that the frequency and intensity of droughts were different earlier. Drought was not as frequent (did not occur in successive years) and was less severe. Moreover, the area affected was smaller and sparsely located geographically. Due to this, people affected in one village could go to nearby areas for resources as well as for job opportunities. They could send their cattle to nearby villages and nearby forest areas for grazing.

Present situation

Currently, production has increased marginally due to better agricultural practices but the availability per household has declined drastically. Population increase with reduced land holding size is decreasing people's ability to cope with drought.

Drought also previously occurred in the villages but now it is occurring in successive years, covering a larger geographic area, which is making life miserable for villagers. With forest cover reduction (due to cutting of trees for fuelwood and sale of timber), they are finding it difficult to feed their cattle during droughts.

With the advent of modernisation, the demand for cash has increased among villagers. People have also become more concerned for personal benefits.

Box 1: Role of Women

The women go twice a day to fetch drinking water from nearby wells and hand pumps in trips taking 10–15 minutes.

During drought when the yield from hand pumps decreases the women are forced to travel longer distances and more often in order to fetch water.

Moreover, they may be carrying two vessels for fetching water but they may not be able to fill both vessels at one time due to scarcity and demand. They therefore have to queue again to get their second vessel filled, thus increasing the frequency of visits and travelling at least 3 km each time to hand pumps. They have to wait for a longer time to fill their pots/vessels, hence the time spent in fetching water is tripled (i.e. covering longer distances, waiting for their turn in lengthening queues and more visits) during drought, which in turn prevents them from performing other productive activities such as on-field activities. This is not possible during drought times.

Source: Village Survey.

Previously, unemployed people would work for others with affected fields or take their cattle for grazing to pasturelands without remuneration. This benevolent attitude is an illusion among villagers today.

Traditional adaptation practices in communities

1. Agricultural activity

Crops

Land holding sizes differ from person to person and average at approximately 3 *bigha*.¹ Small and marginal farmers hold approximately 1–2 *bigha* of land whereas large farmers hold 5 *bighas*. They grow different varieties of crops like *jowar*, millet, groundnut, *bajra*, corn, sesame, *gwar*, pulses such as *moong*, *udath*, *lobia* and *moth* in *kharif* (sown in May–June and harvested in September–October) and wheat, oat, mustard, gram, pea and *channa* during *rabi* (sown in October–November and harvested in February–March).

Due to reduced water availability, farmers have adapted by not growing crops which require greater amounts of water, such as cotton. Wheat requires at least two irrigations of water for its growth and as a result was not grown during the severe drought year of 2002.

Most of the crops grown are used for their own consumption and therefore only a minimum quantity is sold at market. Villagers go to towns to sell their agricultural produce and sell only when they receive reasonable prices. Otherwise they leave their produce with traders, who act as middlemen. The traders keep the produce until they receive a reasonable price for it. They give some advance to the villagers in return for their produce and pay the balance

after selling the rest. However, the traders only give advances to the villagers when they have money with them. When they do not have money, the villagers are left with no option but to sell their produce at lower prices and are thus often exploited by traders.

The farmers have successfully adapted to crops requiring less water and started growing cumin seeds, *chhana* and some oilseed crops like mustard. Crops like *chhana*, cumin seeds and mustard were introduced to villagers by the local NGO, Kumarappa Institute of Gram Swaraj (KIGS).²

These farmers also recently started growing vegetables such as tomato, green chilli, radish, spinach, fenugreek, *brinjal* and carrot. Knowledge on water requirements and demand of different crops/vegetables is provided by KIGS, as is technical know-how and best practices as part of their planned campaign for Gram Swaraj (village self-rule).

2. Animal husbandry

Communities rear different types of livestock including milk stock such as cows and goats, for nutritional value and produce sale, and revenue-earning animals like sheep for wool. Scarcity of water puts a lot of stress on villagers in rearing cattle: during droughts, fodder is a scarce resource; however these communities have traditionally developed ways to store fodder.

The government provides fodder at subsidised rates to farmers Below the Poverty Line (BPL) but fodder amounts depend on the availability within the state, so there is no

Box 2: Food-for-Work Programme

The most prominent measure taken by the government to help poor families and agricultural labourers in times of drought is the Food-for-Work Programme, now re-named the Sampoorna Grameen Rozgar Yojana (SGRY). The programme works on the principle of providing gainful employment to people in drought-hit areas. The guidelines underscore the need to ensure that such work helps in the creation of assets in the respective areas and that surplus grain from the Green Revolution-driven areas are used for this.

The Food-for-Work Programme was re-introduced in January 2001, under which foodgrain is allocated free of cost to states through the Ministry of Rural Development and has been extended to states affected by drought and other natural calamities as a special component of SGRY. States have also been given the flexibility to determine the wage and material components of the work to be undertaken under the Food-for-Work Programme.

During 2001–2, the off-take under the Food-for-Work Programme was 3.184 million tonnes against an allotment of 3.333 million tonnes. During 2002–3 (as on 25 July 2002), 1.811 million tonnes of foodgrain was issued to three states and the off-take was 1.218 million tonnes. During 2002–3, up to January 2003, a total of 1.6478 million tonnes of foodgrain was lifted by states under the special component of SGRY.

Source: www.pib.nic.in

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guarantee of government supply during acute periods of drought. This compels them to buy fodder at exorbitant prices or sell cattle at distressed prices. In extreme cases, many cattle perish due to lack of water and fodder.

3. Storage of foodgrains and fodder

The farmers store grain for future utilisation but the quantity is only sufficient for meeting their requirements for one year (due to reduced production). Fodder for cattle is difficult to get during droughts, so they store as much grain and fodder as possible in small mud structures which can preserve the contents for 1–2 years.

Over time, the farmers have used their knowledge and experience to predict the monsoon and spend on inputs (seeds, tillage) accordingly. The sale of stored foodgrains also depends on their prediction, which normally works well.

The position of large farmers is better, their stock of foodgrain meets their own demand for 3–4 years. They also help the poor during successive drought by supplying food and fodder at reasonable prices.

4. Drinking water

Drinking water requirements of villagers are met by hand pumps and open wells, but scanty rainfall adversely affects the recharge of

groundwater aquifers, leading to reduction in yields of hand pumps and open wells (Box 1).

Moreover, they obtain unsafe drinking water (due to mixing with mud from reduced levels) from hand pumps during droughts, which they purify by filtering with cloth.

The aquifers are also not recharged, lowering the water table considerably. Though the water in wells appears at a depth of 100 ft, the amount available is very little, thus wells have to be dug to greater depths. Water from such a depth cannot be lifted manually, hence the requirement for pumps.

The cost of deepening wells is considerable (3–4 lakhs or £5,000) but villagers opt for it to overcome the drinking water problem. To invest in such activities, they use savings and borrow from cooperatives and banks. Due to ignorance or lack of information, the villagers are not able to access the government-provided subsidies for the digging of wells. Mostly farmers borrow money from the larger farmers and repay the money back to them after a good harvest, but often they also sell jewellery in the market or borrow money from moneylenders at high interest rates, by mortgaging their assets.

Anicuts³ help in recharging groundwater hence their construction augments water availability in wells and hand pumps in future years.

5. Water availability

Water is sourced principally from groundwater and rainwater stored in ponds. During village surveys and interaction with vulnerable communities, people were quite emphatic to say that if they have water, they have everything – drinking water, water for agriculture, for cattle and other day-to-day activities. Since the district received scanty rainfall during the last five successive years, the ponds were not filled, thus groundwater became the only source of water in most villages. Some of the practices adopted to obtain water in water scarce situations include activities like digging new ponds, deepening existing ponds and wells, bunding of agricultural fields and construction of *anicuts*.

(a) *Bunding of fields*. Large-scale levelling and bunding of fields is practised by constructing *med bandhi* (contour bunding) in the agricultural field to keep water in a piece of land. This reduces wastage of water by allowing the excess water from the field to flow to adjacent fields which are at a lower elevation. Bunding and *anicut* structures thus allow optimal utilisation of water by crops.

(b) *Digging and deepening of ponds*. Programmes such as digging new ponds and deepening existing ponds have been taken up by the villagers on a voluntary basis; however, some of these programmes are also supported by the state government.

The Food-for-Work Programme (Box 2) started by the central government as a relief and rehabilitation measure also supports such activities: ponds built under the Food-for-Work Programme are maintained by village communities.

(c) *Digging and deepening of wells*. As mentioned, non-replenishment of aquifers means wells have to be dug up to depths of 400 ft to reach new water sources. The activity is taken up at individual family level: men contribute through labour and money and women obtain loans from self-help groups.

Interventions

1. Medicinal plants

Apart from growing different varieties of crops and vegetables, recently communities have

started growing medicinal plants like *Sona Mukhi*. The experts from KIGS introduced this plant as a revenue-generating plant in the arid and semi-arid regions. It requires less water and minimum care for its growth, as it is not eaten by domestic or wild animals. *Sona Mukhi* is widely used in Ayurveda, Unani, Sidha, Allopathy and other traditional medicines mainly because of its laxative properties.

To cover 1 ha of land, 10 kg of seeds are required at a cost of only Rs200/kg. It can also be harvested three times in a year with 1 ha of land yielding Rs50,000 each year for at least five years and providing seeds for the following year.

The benefits were quickly realised and people started growing *Sona Mukhi* in wide areas. This plant is not a substitute for staple food crops (*jowar*, *bajra*) as it is grown in wastelands, not in agricultural fields, so revenue earned with this plant is in addition to their normal income from growing food crops and helps against future crop failure.

2. Fertiliser use

People have adopted the use of environmentally friendly fertilisers by making compost using earthworms (vermi-composting). After the successful field demonstration of the technology by KIGS, the people found it to be a low investment and less cumbersome process and adopted it immediately. Application of vermi-compost increases the soil moisture, reduces degradation to soil fertility and reduces the water requirement of crops. This provides options for sustainable agriculture and reduces spending on inorganic fertilisers and pesticides.

3. Water harvesting

Construction of anicuts

Scanty rainfall means water storing and harvesting becomes essential during the rainy season. Traditional practices adopted by the villagers were not sufficient to meet their water requirements. They are now preparing *anicuts* to help store water and recharge groundwater in nearby land aquifers and wells. These communities were not aware of conserving water through *anicuts* but awareness generated by local NGOs, including KIGS, helped them to practice this conservation strategy to obtain water in water scarce situations.

Box 3: District Poverty Initiative Project (DPIP)

The World Bank-assisted District Poverty Initiative Project (DPIP) is a major poverty alleviation initiative of the Government. The states of Andhra Pradesh, Rajasthan and Madhya Pradesh and now Chhattisgarh have opted for the DPIP. In 2000–1, the state government of Rajasthan started this new scheme in the seven districts of the state: Baran, Churu, Dausa, Dholpur, Jhalawar, Rajasamand and Tonk. The scheme period is from July 2000 to December 2006.

The main *objectives* are to mobilise the poor in the rural areas and build up their capacities and utilisation of the available resources on the basis of poor people's priorities.

In Rajasthan, DPIP is *implemented through the Department of Rural Development* with the minister of Rural Development at its top. The State Project Management Unit (SPMU) selects different NGOs for a cluster of villages. They help in the implementation of the scheme at district and village level and appoint Block Coordinators and Community Facilitators (CF) (one per three villages). The CFs will constitute the Common Interest Group (CIG) with the BPL families with common economic and social conditions and which are ready to undertake common works. After selection of activity, the CIG will *contribute at least 10 per cent contribution as cash, material or labour and a 90 per cent grant will be provided through the project. For the dairy work, at least 20 per cent contribution is required for cattle purchasing by beneficiaries and the remaining 80 per cent will be provided as a grant.*

Project-related work

- **Income-related activities:** Wooden, leather, agriculture, forest products, fruits, vegetables, dairy, maintenance, sewing, stitching, pickles etc.
- **Land-related activities:** Watershed development, *anicuts*, pond construction and maintenance, forestry/nursery development, dense forest development, barren land development, wells for small irrigation and tubewell constructions.
- **Community activities:** Bridges, clearing and sewage, village lanes (Nale), health centres, *anicuts*, ponds, cattle development centre and pasture development.
- **Social activities:** Lady nurse/*dais* training, animal breed development, education, health and family welfare programme-related activities.

Source: www.baran.nic.in/departments.htm

4. Fodder

Previously, villagers did not grow any fodder crops. But with the intervention of KIGS they are now growing fodder to a great extent, which is benefiting cattle as well as enabling them to earn extra money.

3.7 Role of stakeholders

Government

Programmes started by the government as relief measures in drought-affected areas include providing employment opportunities to affected populations through employment generation works such as waste land development, infrastructure development, construction and maintenance of ponds and *anicuts*. Many civil society organisations are also contributing to the success of these programmes through sensitising communities and involving them in relief and rehabilitation work. The government provided water, solely for drinking,

through tankers in the worst affected regions of Rajasthan during the 2002 drought. Depending upon the type of work the villagers do under the Food-for-Work Programme, the government distributes wheat. Sometimes the total value of relief is divided between wheat and cash. Under the Food-for-Work Programme, wages worth Rs60 (Rs25 worth of wheat and Rs35 in cash) per person is provided to carry out developmental activities like the digging and deepening of ponds. In 2002, the government also provided subsidised fodder for cattle feeding.

Under the District Poverty Initiative Project (DPIP; Box 3), families below the poverty line receive concessional loans from banks for the purchase of cattle. Under the programme, the villagers can get 90 per cent of the prescribed amount as a grant and 10 per cent as a loan for the purchase of cattle. However, in reality the villagers receive only 50 per cent of the prescribed amount

Box 4: Brief Profile of the Kumarappa Institute of Gram Swaraj (KIGS)

The Kumarappa Institute of Gram Swaraj (KIGS) is a grassroots-level NGO registered under Registration of Societies Act No 28, 1958. Over the last three decades KIGS has tried to establish strong sustainable balanced societies by preparing and implementing micro-level development plans based on people's needs. KIGS has been actively involved in the state of Rajasthan and has completed 40 projects so far in the fields of study, survey and socio-economic development of rural people. They receive their funding mainly from bilateral agencies and Government (State and Central).

Rural technology

KIGS, in association with the Department of Science and Technology, Government of Rajasthan, is engaged in propagating improved agricultural implements among villagers by organising road shows and exhibitions. It has taken up extensive science and technology (S&T) programmes and has propagated and given training in low-cost housing, mud blocks, cement blocks, compost making, vermiculture, fire-proof thatchets, herbal pesticides, treatment of fluoride water and soak pits.

Follow-up

In order to carry out the development activities after the project is over, emphasis is laid on building up local institutional structures in the form of Gram Sabha and Gram Vikas Samiti. The local workers of KIGS actively interact with the villagers and provide them with regular guidance and consultancy.

as a grant, due to ignorance of villagers and exploitation by officials. The actual amount they receive does not commensurate with the expenses that they incur in travelling to the district headquarters to access the loan. They therefore prefer to take loans from villagers with high rates of interest rather than loans from this programme. Though the government provides some relief measures to combat drought, the gap between planning and implementing restricts the flow of funds to the real beneficiaries, who therefore do not reap the full benefits of government-funded programmes.

NGO

Intervention by KIGS (Box 4) helped the community to conserve water and to change the cropping pattern and fertiliser use to manage the situation in an efficient manner. Before KIGS came to this village, there were no discussions by women on developmental matters. Now women are starting to discuss the problems in meetings and providing their views as equal partners in the development process.

Some local NGOs also provide seeds for medicinal plants to the villagers and help them to sell the leaves at a better price in the market by involving themselves (NGOs) in this process.

Funding agencies

Several funding agencies are actively working in Rajasthan. GTZ (the German government's aid agency), the Canadian International Development Agency (CIDA), the Swedish International Development Agency (SIDA), USAID, the Aga Khan Foundation, the Council for Advancement of People's Action and Rural Technology (CAPART) are some of the most active agencies working all over the state.

The Indo-German Bilateral Programme (IGBP) on watershed development is active in the district of Tonk. The *anicut*s made under the Indo-German programme help provide water to the villagers in drought, while also increasing the level of water in the nearby wells by recharging groundwater.

Self-help group (SHG)

With intervention from KIGS, the women of the study villages formed a self-help group three years ago, known as "Mahila Mandal". It collects money from each woman of the household and lends it to people who need it in times of emergency. The interest rate charged for the loan is minimal, at 2 rupees/100 rupee loan for one month. Presently there are 20 women members in the group and each member contributes 10 rupees/month. They lend the money for such purposes as serious health problems, to buy seeds from the market and to dig

wells, and the decision to lend money depends on the seriousness of the issue.

3.8 Outcomes of the various interventions implemented

Better water availability through judicious management

The water conservation structures (*anicuts*) helped the villagers to maintain water for irrigating the agricultural fields during winter as well as during the next cropping season. They have thus secured water for agriculture. They did not know before about *anicuts* but the project implemented by KIGS helped them to reap the benefits and cope with droughts. Due to the construction of *anicuts*, groundwater is also becoming recharged and levels of water in wells have improved.

Construction of *med bandhi* (contour bund) in their agricultural fields is also a practice of judicious water use allowing efficient water management by reducing wastage of water and allowing the water to flow into adjacent fields at lower elevations, increasing overall benefits.

Medicinal plants

People have learnt to manage available water resources efficiently by the introduction of medicinal plants and fodder crops that require less water. The demand for leaves and pods of medicinal plants is very high and increasing day by day, due to use in Ayurvedic preparations, herbal teas and bakery products all over the world. The medicinal plants grown help them to earn revenue by selling the leaves. The medicinal plant *Sona Mukhi* (*Cassia Angustifolia*) is helping in wasteland development, where it grows with little water or maintenance. The indirect benefit is that the farmers can now avail sufficient water for their agricultural crops and vegetables. This has helped them economically, due to better harvests from their fields (from judicious water management) and the produce is sufficient to meet their grain requirement for the next 1–2 years. Hence, they also feel secure about their food requirements.

Vermi-composting

The introduction of vermi-composting means soil moisture in the field is conserved. The loss in soil fertility and productivity is reduced and hence yields can improve and demand for water can be reduced as the crops require less. Moreover, the use of vermi-

compost is environmentally friendly and constitutes moving towards sustainable agricultural practices. They do not use 100 per cent vermi-compost in their fields as it would not be remunerative for them, and so use a combination of both organic and inorganic fertilisers.

Growing vegetables

During the winter season these communities are now growing vegetables as well as wheat, helping them to gain better revenues due to higher prices. The knowledge of which vegetables grow is being provided by KIGS. Due to the introduction of fodder crops (*jowar-sorghum vulgare*, *bajra-pennisetum typhoides*, *rajka-medicago sativa*), the cattle are being fed and are now better nourished than before. They produce more milk and it is of a better quality. This is helping farmers to generate more revenue by selling the excess vegetables and milk produce and providing better nourishment through consumption. The shifting to new crops has helped in minimising water requirements and also helped the villagers to change their food habits by increasing nutritional amounts in their daily intake. The fodder crops were also introduced by KIGS.

4 Lessons learned

4.1 For communities

Water management

Water is a scarce resource in the area of this study. People therefore have to manage it efficiently. Besides augmentation of water supply, the demand side management of water is also practised by the people. They have learned to better cope with the problem by changing their traditional cropping pattern, which in turn has helped them to become economically more stable. The growing of fodder crops, which require less water, and the medicinal plant *Sona Mukhi* for its multifarious tangible benefits, have been widely taken up by the villagers.

The communities learned to construct and maintain simple water harvesting and conservation structures such as the construction of *anicuts* and runoff structures. They also learned to grow crops on the bunds of agricultural fields and how to use crop species which require less water and which are apt for such conditions.

Food preservation: the use of neem leaves

Villagers are aware of their vulnerability and are trying to increase their resilience and coping capacity by

Box 5: National Agricultural Insurance Scheme (NAIS)

The National Agricultural Insurance Scheme (NAIS) was introduced in the country in the 1999–2000 *rabi* seasons, replacing the Comprehensive Crop Insurance Scheme (CCIS) which was in operation in the country since 1985. The scheme is being implemented by the General Insurance Corporation (GIC) on behalf of the Ministry of Agriculture. The main objective of the scheme is to protect the farmers against losses suffered by them due to crop failure as a result of natural calamities such as drought, flood, hailstorm, cyclone, fire, pest/diseases etc., so as to restore their credit worthiness for the following season.

The new scheme is available to all farmers regardless of their land holding or indebtedness. It envisages coverage of all food crops (cereals, millets and pulses), oilseeds and annual horticultural/commercial crops, if past yield data is available for an adequate number of years. The new scheme operates on the basis of an area approach, i.e. defined areas for each notified crop for widespread calamities and on an individual basis for localised calamities, such as, hailstorm, landslide, cyclone and flood. Individual-based assessment in the case of localised calamities would be implemented in limited areas, on an experimental basis initially, but will be extended in light of operational experience gained.

Under the new scheme, each participating state/or Union territory (UT) is required to reach the level of *Gram Panchayat* (village council) as the unit of insurance in a maximum period of three years. The premium rates are 3.5 per cent (of sum insured or actuarial rates, whichever is less) for *bajra* and oilseeds, 2.5 per cent for other *kharif* crops, 1.5 per cent for wheat, and 2 per cent for other *rabi* crops. In the case of annual commercial/horticultural crops, actuarial rates are being charged. A 50 per cent subsidy in the premium is given to small and marginal farmers who are selected by their communities. The subsidy is shared equally by state/UT and Central Government. The subsidy in premium will be phased out on a gradual basis over a period of five years.

At present, the scheme is being implemented by 21 states/UTs. These states/UTs are *Andhra Pradesh, Assam, Bihar, Chattisgarh, Goa, Gujarat, Himachal Pradesh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh, West Bengal, Andaman and Nicobar Islands and Pondicherry*.

practising various indigenous methods like making insecticides out of cow urine and using neem leaves for preserving stored foodgrains. They use the leaves of the neem tree (*Azadirachta indica*) for preserving the foodgrains in their indigenous storage structures. They have also adopted changes in fertiliser use by using vermi-compost to a greater extent.

Strong presence of the local NGO

Technical support for most of the above innovative methods has been provided by the local NGO, KIGS. The strong presence of KIGS has benefited them beyond their expectations, which they sincerely acknowledge. The villagers were of the opinion that the NGO would work for few months and then leave the village. But KIGS continued its development activities and, over time, widened its field of activities. Now they are looking after the overall development of the village and introducing new ideas for economic and social betterment of the poor people.

At the beginning, the NGO had problems in gaining entry to the village. They raised awareness of potential benefits with the few educated people in the village and showed them ways to improve their standard of living. They took male elders representatives of the village on field trips where they could get firsthand knowledge of what KIGS does and how their intervention is positively affecting the people in other villages. Only after that did they gain the confidence of the villagers and were able to work. Soon the villagers realised the benefits and within a couple of years the NGO was well accepted.

Empowerment of villagers

Raising awareness about the water crisis occurring in the state and, more importantly, communicating ways to overcome the crisis to the people is critical. Water harvesting structures should be constructed and people should be trained with skills to maintain them. Training should be imparted to the villagers

Box 6: National Dairy Development Board (NDDB)

The National Dairy Development Board (NDDB) was created in 1965. The NDDB began its operations with the mission of making dairying a vehicle to a better future for millions of grassroots milk producers. India's 10,3281 village-level dairy cooperatives integrated through a three-tier cooperative structure – owned by more than 10 million farmers, they procure an average of 16.5 million litres of milk every day. The milk is processed and marketed by 170 milk producers' cooperative unions which, in turn, own 15 state cooperative milk marketing federations.

Since its inception, the NDDB has planned and spearheaded India's dairy programmes by placing dairy development in the hands of milk producers and the professionals they employ to manage their cooperatives. The NDDB also promotes other commodity-based cooperatives and operates in over 285 districts. It is responsible for the following:

- India's milk production increased from 21.2 million tonnes in 1968 to 84.6 million tonnes in 2001–2.
- *Per capita* availability of milk is presently 226 g/day, up from 112 g/day in 1968–9.
- India's 4 per cent annual growth of milk production surpasses the 2 per cent growth in population; the net increase in availability is around 2 per cent per year.
- The annual value of India's milk production amounts to about Rs850 billion.
- Dairy cooperatives generate employment opportunities for some 11 million farm families.

Source: www.nddb.org

on any innovative techniques that are being introduced by other stakeholders. These groups should demonstrate the technique, monitor village performance and only when they find it satisfactory should they leave it to the community.

Policy level schemes and programmes for drought-affected areas and communities

There are a number of government schemes such as the Food-for-Work Programme and DPIP. The schemes, if effectively implemented, can help the villagers considerably. But there are hindrances in their way; one is the lack of awareness in the communities for accessing such benefits. There is a need for proper dissemination of such information to vulnerable communities, showing how such schemes can be accessed (the modalities, procedures, from where etc.) to make funds available to them.

Fodder is being supplied to the villagers at a subsidised rate by establishing fodder depots at various affected areas. The initiative is taken up by NGOs (UN volunteers, Red Cross, Oxfam) as well as the state government, but they work with little coordination between them creating confusion among the villagers and reducing the effectiveness of the programmes. State machinery should ensure such activities are well coordinated at both policy and local levels.

4.2 For regional/national policy-makers

The government should have confidence in the local NGOs active in the area, and simplify procedures for accessing government schemes and programmes. The government should set up a mechanism for evaluating programmes to ensure the practical implementation of its schemes. In most cases, the gap between planning and implementation stages prevents the flow of funds from reaching beneficiaries. Effective coordination between the planning and implementation stage is required for the successful completion of such programmes. The low uptake of the DPIP is also due to existing malpractices and corruption at various levels in the government machinery, and their close nexus with the open-market traders.⁴

The state suffers from poor irrigation facilities due to scarce water availability. The government should develop and implement a detailed and extensive irrigation network system in the state to provide water to the most remote people in a village.

The state government should support cultivation of non-traditional crops like cumin seeds, *chana*, oil seeds and fodder crops like *rajka-medicago sativa*. The support may be in the form of incentives and research inputs about the variety and methods of cultivation practice that should be followed. Information on these government incentives and research outputs should be communicated through extension workers.

Despite repeated crop failure in Rajasthan, the state has not launched an effective crop insurance scheme to minimise losses. Agriculture is a state subject; hence the National Agriculture Insurance Scheme of the Central Government is not being taken up in all states (Box 5). The present crop insurance scheme is not successful due to a number of reasons: its coverage has been limited, procedure cumbersome and unclear to farmers, and settlement of claims is time consuming. Initial implementation has shown its complexity and impracticability.

Access to services like information, knowledge, banking and healthcare should be provided to people through efficient mechanisms, and government officials need to be more accountable and responsible for proper implementation of the schemes.

Access to markets and inputs is one of the major problems faced by marginalised farmers. For easy access to markets, transportation and proper roads should be developed in rural areas. Lack of access means the poor are often forced to sell produce at low prices. This is the case for both foodgrains and fresh perishable products like vegetables.

Foodgrain banks at the village level could be a possible solution. Cold storage facilities at the next higher level (block level) are also a necessity to prevent the exploitation of the marginalised farmers. Both of these are cost intensive, thus a strong policy backed by financial support is imperative.

The scope of the Food-for-Work Programme should be strengthened and widened to provide gainful employment opportunities to the poor. Relief work of programmes like Food-for-Work should start as soon as the monsoon forecast is received from the India Meteorological Department. Nowadays the programme starts only after the monsoon fails: the programme should be *preventive*, starting well before the monsoon months, rather than curative, as it is at present. The area of the work should be widened to include other developmental activities like development of infrastructure (road), construction of storage facility for foodgrains, construction of *anicut*s and should be diversified to include various income-generating activities. This would employ more people for a longer period of time and lead to the overall community development, increasing their resilience and coping capacity.

Proper care should be taken for cattle development because cattle rearing is an important revenue-earning activity. Though most of the milk is used for villagers' own consumption, a certain

quantity is sold in the market, despite the absence of an organised market. A cooperative set-up like the National Dairy Development Board (NDDB; Box 6) would be helpful for poor people.

4.3 Financial interventions

Financial intervention is required for smooth functioning in all sectors for all activities. This is key to the success of any developmental process. Activities like de-silting and digging ponds and deepening wells are cost intensive. Financial support from the government is urgently required for these types of activities in addition to subsidies on agriculture. Once the people are forced to sell their cattle at distressed prices they have to start from scratch again; financial help at this point is required and the government should take the initiative to make such finances available to them through simplified procedures. Grants or soft loans for buying cattle would be a better option than loans that poor people take from money lenders at high interest rates.

For infrastructure development, irrigation facility, transport, communication and early warning systems, large-scale finances are required; these need to be provided by the government, though intervention of bilateral/multilateral funding agencies is also welcome.

5 Recommendations

- Specific case studies to capture regional and local dimensions are required. For this, there is an urgent need for pilot implementation studies. These implementation studies should be at micro- (village) – as well as macro- (district, state) level. The implementation studies should focus on the community-based natural resource management of various sectors, such as agriculture, animal husbandry, land and soil, forests and, of course, water. There is a need for a linking cross-sectoral impacts study.
- The prime adaptation challenge facing the country is, therefore, the need for resources to implement adaptation measures. It is recommended that the available limited resources should be efficiently managed to meet the adaptation challenges.
- Though planning is being linked to developmental activities in the country, there exists a huge gap between planning and implementation. Proper care should be taken to reduce these gaps. This calls for efficient

monitoring of implementation of government programmes. Top-down planning for rural development needs to be replaced by bottom-up planning to help vulnerable communities.

- There is a need to deal with equity issues and development constraints in market responses. Market responses must be matched with extensive access to insurance, widespread introduction of micro-financing schemes and development banking.
- There is a need for enhancement of awareness at all levels on adaptation needs.
- The policies should give more focus on preparedness rather than relief.
- Food programmes and other social security programmes would provide insurance against local supply changes.
- A viable risk coverage policy is needed for a farmer-friendly credit delivery system. No crop insurance scheme or risk coverage programme for the farmers can succeed unless it has taken into account grassroots realities and addresses implementational and operational problems. Therefore it is recommended that the government should redesign a simple, easy-to-operate and clearly understood insurance scheme after a thorough examination of its practicability and in the light of problems which face the farmers both in the coverage and settlement of claims. It should aim to be inclusive and transparent. The state of Rajasthan should take the initiative to implement the National Agriculture Insurance Scheme (NAIS) with maximum coverage of *kharif* crops.
- Infrastructure facilities like transportation, distribution and markets need to be improved.
- Existing policies may limit efficient responses to climate change. Changes in policies such as crop subsidy schemes, land tenure systems, water pricing and allocation and crop insurance schemes could increase the adaptive capability of agriculture.

The experience of the villagers and scientific records confirm the fact that the intensity and severity of drought has increased in recent years. The climate change projections reaffirm this fact. Hence long-term adaptation strategies that will help people over time, need to be implemented. Besides communities' perception about drought, there is a need to quantify the impacts through proper

scientific studies and investigation. There is no single best coping strategy. The best choice is a function of many factors pertaining to economic efficiency, risk reduction, robustness, resilience and reliability. This implies that it is essential to create a common framework at different levels to move towards the integrated management strategies starting from the *Gram Panchayat* (village council) to higher levels. Integrated management does not simply mean the amalgamation of different activities under one administrative umbrella. It also requires the collation of relevant information so as to evaluate the cause and effect of proposed actions.

The most important recommendation that emerges from this Rajasthan case study is that:

- Each vulnerable region/country must take up a minimum three-year programme (both bottom-up and top-down) of adaptation studies for mainstreaming within the country's/region's development process. This should include different geographical areas with communities vulnerable to droughts, floods, sea level rise and cyclones. Such funds should be provided by the national government, the UNFCCC and other multilateral agencies for increasing the resilience and coping capacity of vulnerable communities at varied geographical locations.

6 Conclusion

Due to their lack of technological and financial resources, developing countries will be the worst hit by the adverse impacts of climate change. Poverty automatically makes such countries and people vulnerable to these impacts. Adaptation measures in developing countries should therefore be linked with sustainable development initiatives to seek to reduce a community's vulnerability to shocks by enhancing portfolios of social capital, including access to natural, physical, financial, technical and human capital – thus enhancing the ability to cope with climate change.

In order to use adaptation as an effective way of responding to climate change, measures will be required to increase the adaptive capacity of systems and communities. Wealth is one of the most important factors determining adaptive capacity and must be blended with scientific understanding, awareness raising and access to technology and technological skills. Availability of appropriate institutions is also very important. Adaptation is very site specific; hence

extensive research is required at different locations to understand their adaptation needs.

Adaptation occurs in both natural and socio-economic systems. In the case of natural unmanaged ecosystems, adaptation may be difficult. Such systems should, however, not be left entirely to chance; through proper policies and practices adaptation measures in such ecosystems must be tried out. Similar to natural systems, socio-economic systems (e.g. agriculture, forestry and water resources) also need to change to fit new conditions

of a changing climate. This includes adaptation by farmers, farm suppliers and consumers of farm products. To support them, there needs to be sound agricultural policies. The same is true for all other socio-economic sectors. Adaptation measures may be short-term or medium- to long-term activities. Long-term adaptation is an ongoing process that involves ecosystems and socio-economic systems in their entirety, and thus all components must be considered for adaptation to future climates.

Notes

1. 7.5 *bigha* = 1 ha.
2. www.kigs.org
3. *Anicuts* are small- to medium-sized check dams, which act as reservoirs of water. The height of the *anicut* above ground level is about 10–22 ft and it is constructed on a river bed or small stream bed. *Anicuts* are built to serve many purposes, among which the recharge of

groundwater, providing water for consumption for animals, for bathing for men and women, and providing a reservoir of water in water scarce years, are critical.

4. The officials get a certain amount of foodgrains to be distributed to BPL families at a subsidised price. They sell these foodgrains to traders at a profit, who then sell them in the market. The prices they sell at are much higher than the price they paid the officials.

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